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Encouraging the implementation of small renewable electricity CDM projects: An economic analysis of different options

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Abstract

Apart from contributing to the mitigation of GHG emissions, the deployment of renewable electricity Clean Development Mechanism projects (RE-CDM) may provide substantial local economic, social and environmental sustainability benefits to host countries. However, in spite of these advantages, a wide array of barriers prevents the realisation of these projects. They compete with other CDM options which lead to cheaper GHG emissions reductions but which do not provide as much opportunities for sustainable development in developing countries. Taking into account that, in contrast to GHG benefits, sustainability benefits are not valued in the market place and that article 12 of the Kyoto Protocol envisages two objectives for the CDM (cost-effective emissions reductions and contribution to sustainability), this market mechanism might be leading to a "market failure" in RE-CDM projects. This paper explores the different barriers affecting the implementation of RE-CDM projects and proposes and analyses several policies and measures that could be implemented to encourage their deployment by tackling those obstacles.

Keywords: Renewable energy; Clean Development Mechanism; Sustainable development

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1. Introduction

The world community faces two major and interrelated problems in a sustainability context. One is global climate change. The other are economic, ecological and social problems suffered by developing and less developed countries (non-Annex I countries). The Clean Development Mechanism (CDM) may contribute to the mitigation of both problems since, according to article 12 of the Kyoto Protocol, it should make compatible cost efficient abatement of GHG emissions with the improvement in the sustainable development potential of poorer countries by promoting the transfer of, both, financial and technological resources from developed to less developed countries.

A wide range of eligible CDM projects can lead to creditable reductions of GHG emissions. This paper concentrates on one of these possibilities: electricity from renewable energy sources (RES-E). Apart from contributing to GHG emissions mitigation, the deployment of renewable electricity CDM projects (RE-CDM) may provide substantial economic, social and environmental sustainability benefits to host countries.

However, in spite of these advantages, a wide array of barriers prevents the implementation of these projects. This paper explores the barriers to the implementation of RE-CDM projects and proposes several alternatives to encourage their deployment, taking into account those obstacles.

Accordingly, the paper is structured as follows. The following section provides a brief overview of the options, characteristics and sustainability benefits of RE-CDM projects. The barriers to their implementation are explored in Section 3. Section 4, which is the core of this paper, proposes and analyses several options to encourage their deployment. The paper closes with some concluding remarks.

2. RE-CDM projects: modalities, characteristics and sustainability benefits

The RE-CDM projects considered in this paper are particularly those with of a small size or those which are not profitable at the margin, simultaneously contributing to the sustainability of the host country, such as solar (thermal and PV) and wind electricity.

CDM projects in general and RE-CDM projects in particular have a large potential to contribute to the three dimensions of sustainability in non-Annex I countries:

- *Economic sustainability*: CDM projects allow host countries to receive a transfer of financial, technological, and human resources increasing development, employment and investment opportunities. Benefits from so-called decentralised generation in general and renewable electricity in particular include higher energy security and availability and a more diversified energy mix, reducing fossil fuel dependency.[1] Small projects have a larger potential to contribute to local sustainability (poverty alleviation and employment generation) than larger projects [3].
- *Social sustainability*: Human capital formation, job creation and building of local capacity may be provided to host countries. In addition, there might be significant equity advantages (income distribution) due to the participation of unskilled workers in the project and the effects of the distribution of the resulting environmental benefits on different income groups [4].
- *Environmental sustainability*: RE-CDM projects may reduce local environmental impacts.

Given the modular characteristics of some renewable sources, renewable electricity allows those places that are far from the electricity grid (rural and isolated areas) to enjoy an energy supply, also contributing to meet the increasing demand for energy for those with access (mainly in the cities). RE-CDM projects would thus help reach the eight Millennium Development Goals (Box 1), given the direct link between access to energy and poverty alleviation.

RE-CDM projects also bring a "dynamic efficiency" benefit, contributing to continuous technological change over time and to more sustainable energy systems in the future.[2] In fact, the initial expectations was that the CDM would greatly encourage the transfer of investments and technologies from developed to less developed countries and, more generally, spur technological change.[3] Some commentators argue that, up to date, the CDM has proven relatively ineffective to boost renewable energy sources in developing countries (for example, see [5]). The following section analyses the barriers to RE-CDM projects.

[1] See [1,2] for a complete discussion of the benefits of decentralised generation and renewable energy to sustainable energy development.

[2] According to the Marrakech Accords, CDM projects should lead to the transfer of environmentally safe and sound technologies and know-how.

[3] In addition, it has been argued that the CDM could have significant "leveraging power", i.e., it can stimulate more investment capital (than that provided by the CDM project strictu sensu) by several orders of magnitude.

Box 1
The contribution of renewable energy to the achievement of the Millennium Development Goals.

1. *Eradicate extreme poverty and hunger*: Electricity is essential for job creation and industrial activities.
2. *Achieve universal primary education*: In order to attract teachers to rural areas, houses and schools should have electricity. Good lighting conditions are necessary to study overnight.
3. *Promote gender equality and empower women*: Lack of access to electricity contributes to gender inequality because it frees up women from domestic tasks.
4. *Reduce child mortality*: Respiratory problems due to air pollution within houses as a result of traditional fuels and stoves cause diseases.
5. *Improve maternal health*: The pollution within the house, lack of electricity for health centres, lighting for night births and the day-to-day heavy physical load of recollection contribute to bad maternal health.
6. *Combat HIV/AIDS, malaria and other diseases*: Electricity for communication through radio and TV may help disseminate useful information on public health.
7. *Ensure environmental sustainability*: Conventional energy production, distribution and consumption have negative effects on the local, regional and global environment.
8. *Develop a global partnership for development*: The Johannesburg World Summit on Sustainable Development called for partnerships between public entities, development agencies, civil society and the private sector. This involves the promotion of environmentally sustainable and reliable energy services at reasonable prices.

Source: [32].

3. Barriers to the implementation of RE-CDM projects

Although CDM projects generate an annual income through the sale of CERs which cover a significant part of the O&M costs and provide the project developer with the opportunity to access funding sources which are out of reach without the CDM (given the additional guarantee to investors provided by the CDM), several layers of barriers to the implementation of RE-CDM projects stand in the way (Fig. 1). These sets of barriers are interrelated and/or mutually inclusive and they should be considered in order to propose the most appropriate policy measures to remove them.

3.1. *Level A (general): barriers to cleaner technology adoption and technology transfer

While several economic approaches have been used to analyse the barriers to technological change, the relatively recent evolutionary economics of technological change

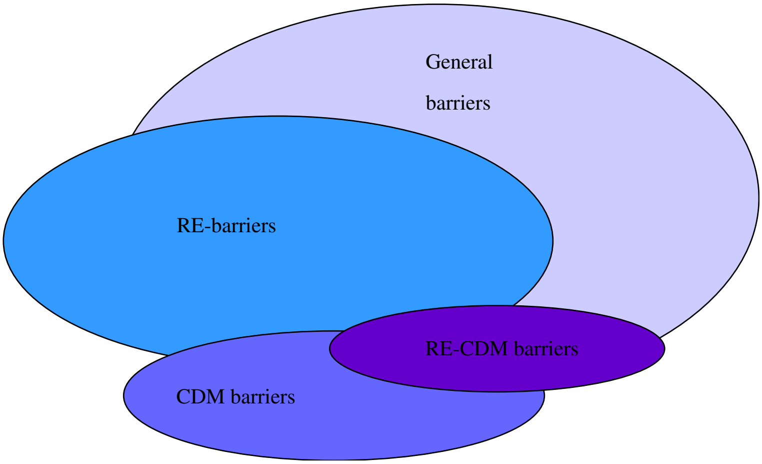

Fig. 1. Barriers to the deployment of RE-CDM projects. *Source*: Own elaboration.

groups the barriers to technological adoption and diffusion into three major categories [6]: pressures from the external environment, characteristics of the technologies (including costs and benefits from adoption) and characteristics of the adopters. In general, there is a certain inertia to use old technologies, because the users are familiar with these technologies and often distrust the new ones, given the lack of experience with them (lock-in). Single barriers are usually a necessary albeit not a sufficient condition for non-adoption. Their systemic interplay makes them a sufficient condition for lock-in.

However, the above categorisation is too general when applied in an international context. Barriers to the international transfer of technologies, including the literature on the determinants and barriers to FDI flows should also be considered (for an overview, see [7]).

3.2. *Level B: barriers specific to renewable electricity technologies*

The aforementioned general barriers should be made more specific to analyse the obstacles to the adoption/diffusion of renewable electricity technologies (RETs). The major obstacle is the comparatively higher private costs of renewable versus conventional electricity and their high up-front (capital) costs. Since decisions on adoption are taken on the basis of these private costs, RETs are unlikely to be adopted unless their "social" benefits translate into public support, reducing the cost gap, as done in the EU, where all the MS provide additional support to these technologies.

In addition to the higher generation costs, the inertia of power system investment and the lock-in in conventional generation technologies also depend on non-price variables. There are several factors causing lead times, high transaction costs and risks for investors in RETs which may hinder or delay their adoption, such as delays in obtaining the necessary administrative permits to build the renewable facilities or difficulties in accessing the grid. The characteristics of some RETs (i.e., intermittency) may also be a performance barrier with respect to conventional electricity sources. Non-awareness of the benefits of RETs, lack of knowledge on the new technology (including wrong perceptions) by users

and other actors, high discount rates and poor access to adequate financing may also be relevant barriers.

When adoption of RETs is specifically considered in developing countries, the most relevant barriers for the implementation of these technologies are: poverty (investment costs are frequently prohibitive for rural populations), lack of know-how and skills in decentralised rural electrification technologies, the low involvement of rural development agencies, limited access to power markets, stiff competition from subsidised conventional energy, high capital investment and limited access to adequate capital at affordable cost [8,9]. This is in spite of renewable energy resources being abundantly available.

In this context, the CDM offers an opportunity for co-financing through the sale of CERs and may positively affect RE deployment in developing countries. However, only by itself the CDM is unlikely to substantially increase the deployment of renewable electricity projects, due to the special problems related to the diffusion of RETs. The CDM may only make a limited contribution to mitigate these barriers, however. The additional revenues provided by the sales of CERs and the greater confidence for investor banks (lower uncertainty) can only partially tackle the higher generation cost barrier. In addition, the other barriers are not dealt with. Specific barriers to the implementation of RETs should be considered when proposing measures to mitigate those barriers in the framework of CDM projects.

3.3. *Level C: barriers and factors specific to CDM projects

Investment in CDM projects in general (and RE-CDM in particular), face three major groups of barriers:

3.3.1. Transaction costs

They increase the costs of CDM projects and reduce their profitability. These transaction costs include search, negotiation, baseline determination, approval, validation, registration, monitoring, verification, certification, enforcement, transfer and registry costs. Some of them are fixed (independent of the size of the project) and, thus, the larger the project, the lower the impact of fixed transaction costs, discouraging the realisation of small projects. The existence of an accurate institutional capacity to host CDM projects in the host countries is crucial to keep some transaction costs at reasonable levels.[4]

3.3.2. Additional risks for investors

The realisation of a CDM project entails several risks, additional to those linked to an investment project in a developing country.[5] They do not only directly discourage project

[4]It is considered that the ratio transaction cost/revenues from the sale of CERs should not be above 10% for the project to be attractive for the investor [3]. The fixed cost part of the transaction costs is higher for small-scale projects (almost 50% compared to 30% for normal projects) [3]. Most of the transaction cost reduction as a result of simplification of procedures is in the non-fixed part (monitoring and verification). This would reduce the fixed component of transaction costs [10]. For other authors, however, the scale of CDM activity is relatively insensitive to changes to transaction costs and marginal abatement costs with other factors playing amore relevant role (growth of emissions of Annex B countries and the share of hot air sold) (see [11]).

[5]The CDM also reduces some risks. The additional support and the political commitment that CDM provides, gives the project investors some confidence in implementing a risky first time activity.

developers from implementing a CDM project but also discourage banks from funding those projects.

(i) *Political risks*: If either the investor or the host country does not comply with the eligibility criteria, then the CERs generated cannot be used to comply with the mitigation targets. Particularly relevant is the lack of post-Kyoto targets, which, combined with the long lead times for most CDM projects, may restrict the implementation of these projects.[6] For example, Haites shows that failure to ensure a market value for post-2012 emissions reductions soon would limit the CDM to an annual supply of 50–90 Mt CO_2 in 2010, instead of 250 Mt CO_2, with almost no new CDM projects after 2007 [10]. Buyers currently have little interest in reductions achieved after 2012 so these reductions have virtually no market value at present.
(ii) *Performance/technical risks*: Less polluting technologies may lead to lower reductions of emissions than previously expected, leading to less CERs earned.
(iii) *Market risks*: The expected market price of the CERs generated may vary considerably, affecting the revenue of the project. This price depends on many variables, some of which are difficult to predict (see below).
(iv) *Risk of duration of the crediting period*: If it is decided to renew the crediting period, then the total duration of the crediting period is not fixed with total certainty.[7]
(v) *Risks on costs*: Abatement and transaction costs may be higher than initially considered.
(vi) *Contract risks*: The seller of CERs may not hand the CERs to the buyer at the date previously agreed.
(vii) *Other risks*: For example, there might be an unwillingness of the financial community to recognise CERs to manage financial risk [5]. The Executive Board may not approve the methodology proposed by the project developers or the validation and verification report. The Operational Entity may reject the methodology or the host Designated National Authority (DNA) may consider that the project does not contribute to its sustainable development.

3.3.3. Other barriers

- *Barriers related to the financing of projects*: Bhardwaj et al. observe that, in general, financial institutions are not eager to finance projects (especially when these are small) [3].
- *Institutional/organisational barriers*, i.e., lack of institutional capacity by non-Annex I countries to identify, attract and develop CDM projects.
- *Low CER prices*: A major factor affecting CER prices is the “hot air” issue. As shown by econometric models, if Russia and Ukraine decide to sell all their surplus AAUs in the international market in the first commitment period, the price of Kyoto units and the demand for CERs will be low. The lower costs of surplus AAUs from Russia and

[6] If a project is to recover its costs from the sale of CERs for the reductions achieved prior to 2013, it must begin to achieve emissions reductions between 2001 and 2007 [10]. If the average CDM project lead time is 4–5 years, projects with a start date after 2004 will not be able to recover their costs from the revenue received from emissions reductions achieved through 2012.

[7] CDM project developers may choose between a crediting period of 10 years or a crediting period of 7 years with two possibilities for renewal (i.e., a maximum of 21 years).

Ukraine would outcompete CERs, which are more expensive. Somehow paradoxically, strategic behaviour by Russia and Ukraine would help the CDM and, particularly, the most expensive CDM projects.

- *Size matters*: Given the fixed transaction cost component, small projects have relatively more transaction costs in relation to their revenues and can be less attractive for the investor.[8] Many RE-CDM projects do not exceed the minimum threshold over which a CDM project is considered to be potentially economically viable.[9]

On the other hand, some future general developments may positively affect RE-CDM projects:

1. *Increasing CER prices*: CER prices depend on the interaction of demand and supply. Currently, the market is probably monopsonic (buyer-dominated) and, therefore, low CER prices result, negatively affecting RE-CDM projects. Many observers expect CER prices to rise, but the size of the CDM may well shrink if there is too much availability of AAUs and ERUs as a result of hot air countries deciding not to bank these to future periods.[10] Other policy trends may increase demand for CERs. For instance, the combination of the Emissions Trading Directive (which sets targets on emissions) and the EU linking Directive allows CERs to be exchanged for EU allowances to meet those targets, ensuring demand for CERs after 2012, and maybe a boost to the CDM market. Demand by governments will continue to represent an important share of the CERs market, between 45% and 75% of total demand in 2010, according to Haites [10]. This demand may have considerations other than cost-effectiveness and "cheap" CERs, such as contribution to sustainability, for political reasons. In addition, some Annex I countries are likely to overshoot their Kyoto target by more than previously expected, given the lack of control on the emissions of "diffused" sectors. If this was the case, the recourse to the CDM and the demand for CERs would increase. Finally, CERs supply in countries like China or India would affect the CDM and CER prices and Australia (not to say US) ratification would push up the CER price.[11]
2. *Reduction of transaction costs*: Transaction costs are expected to come down through learning. The actual implementation of the CDM and specific projects may pinpoint transaction cost barriers and ways to address them at different levels and by different actors. It should be analysed which transaction costs are likely to be reduced and which do not, however.
3. *Increase in energy demand*: The strong growth of energy demand in some parts of the world increases the range of potentially profitable technologies of interest to developing countries, including renewables, since it would make competitive otherwise

[8]Renewable energy projects with a maximum capacity of 15 MW can be included in the small-scale project category.

[9]Haites estimates that, to be economically viable, a CDM project should reduce emissions by at least 100 000 t CO_2/year, although analytical studies suggest a minimum project size of 50 000 t CO_2/year. Transaction costs in this case would amount to 25% of the market price (at a price of 5.5$/t CO_2e) [10].

[10]For example, Haites shows that Russia and Ukraine have an incentive to behave strategically to bank 60% of their surplus AAUs and sell 40% of this surplus because doing so would maximise their revenues [10].

[11]According to Haites [10], if China implements projects on a scale consistent with 10–15%, rather than 35–45% of the total CDM potential, the total supply is reduced by 25–30%.

uncompetitive RETs, due to the increasing marginal costs of conventional electricity and to the profitability of RETs investments in specific niches (isolated, rural areas).[12]

4. *RETs cost reductions*: This would make RETs more competitive compared to conventional sources. Learning effects and economies of scale will significantly reduce costs, particularly in solar and wind technologies, making the realisation of RE-CDM projects more attractive.
5. *Development goals*: International political commitments to reduce world poverty and achieve the aforementioned Millennium Goals may encourage the realisation of RE-CDM projects, given their greater contribution to sustainability.
6. *Renewable energy focus*: Already approved small-scale provisions and top-down methodologies are beneficial for RETs. This trend for simplified procedures may continue in the future for small-scale and certain project categories.
7. *A positive market trend*? Several energy multinationals and firms from developed countries are taking up the commercialisation challenge of renewable energy sources by drastically expanding their investments and acquisitions in the area of solar, biomass and wind technologies. This trend would be positive for (and would benefit from) the deployment of RE-CDM projects.
8. *Attractive features*: Specific features of RETs (modularity, flexibility, low operating costs and the ability to create new strategic options for the future) can make them attractive versus conventional technologies.

3.4. *Level D: barriers specific to RE-CDM projects

In general, the profitability of RE-CDM projects depends on several factors: market price of the CERs generated, renewable energy potentials, certain and favourable baselines and price of conventional electricity sources, existence of sources of funding additional to the sales of CERs and capacity reserve.[13]

Although RE-CDM projects are the more numerous in the CDM project portfolio,[14] they are usually small-scale and, thus, the share of CERs from RE-CDM projects is much lower than their share in the total number of projects, leading to other projects being more profitable in terms of CERs earned. In addition, certain market experts observe that RE-CDM projects are likely to lose market quota in the following years [13] as the role of public funding, which has been crucial for RE-CDM projects in this initial stage, will probably go down, once the market is more mature and more private investors get involved.

Although RE-CDM projects have currently a large share of the CDM project portfolio, data on CDM potentials suggest they may be overrepresented.[15] RE-CDM projects may have already achieved a significant part of their potential and their share may go down in the future.

[12]One of the major barriers to the deployment of RETs are the investment plus O&M costs they incur, whereas existing conventional energy sources only face O&M costs. While O&M costs for RETs are generally lower than for conventional sources, the agreement of investment + O&M costs is much higher than the O&M costs of conventional sources. Increasing the electricity demand means that new conventional electricity plants would have to be built, which could make them uncompetitive in certain applications with respect to renewable electricity plants. This is why, ceteris paribus, a higher electricity demand would be beneficial for RE-CDM projects.

[13]Duic et al. show that the profitability of a RE-CDM project may depend significantly on the need to create a capacity reserve (through the installation of conventional technologies), especially for intermittent renewables [12].

[14]Ellis et al. show that electricity generation from renewables (biomass, hydro and other renewables) account for 57% of all projects but only for 37% of the expected emissions credits [13].

[15]For example, for Trexler and Associates, the CDM potential of RE-CDM projects in 2010 would represent between 7.8% and 3.8% of total CDM potential. For Sijm et al. [14] this figure would represent 14%. In contrast,

In a context of relatively high risk perceived by investor and low CER prices, investors are especially willing to invest in low-cost projects, which lead to more CERs per € invested. As shown by Halnaes [15], among others, abatement costs of RE-CDM projects are generally higher compared to other CDM project types with which they compete (energy efficiency, removal of HFC_{23} and F-gases, etc.).

The CDM will not provide a panacea for large-scale renewables promotion, especially if CER prices are low (5€/t CO_2). According to Michaelowa et al., "the CER prices that can be achieved by renewable energy project developers under (…) CDM range from 2.5 to 12 € and depend on the buyer" [16, p. 6]. This only makes viable those projects whose profitability is close to the market (wind and large hydro), whereas other technologies (PV) are still too expensive and it is unlikely that awarding CERs (with those prices) will make them attractive for investors.[16] Bernow et al. show that carbon credit prices are likely to be the major factor that can stimulate greater renewable generation [17]. The price should be very high in order to promote RETs. For example, at a price of 10$/t C, the increase in renewable energy deployment induced by the CDM would "only" be between 16% and 26%, while it would be between 178% and 308% at an unlikely price of 100$/t C.[17] The improvement of the IRR of a renewable energy project as a result of the CDM is rather limited, generally between 1% and 2% [18,19].[18]

RE-CDM projects are generally smaller than other project categories. This means that there are fewer economies of scale in creating CERs and that they face relatively more transaction costs. The following table shows the typical reduction and transaction costs of RE-CDM project types. The problem is that, in addition to higher transaction costs, smaller projects tend to have higher marginal abatement costs [21], seriously compromising their viability (Table 1).

Finally, renewable electricity projects have more difficulties to prove their additionality than most other project types because it is more difficult to predict "what would have happened in the absence of the project", given the many variables involved in the electricity sector. The existence of plans to implement RETs promotion policies in the host country could lead to a problem in justifying additionality and/or to unfavourable baselines (see Section 4). Table 2 provides an overview of the barriers faced by RE-CDM projects.

Obstacles to the deployment of RE-CDM projects would not be problematic if cost-effectiveness in GHG mitigation and sustainability contribution worked in the same direction, but they do not (Fig. 2). Usually, those projects with the highest costs per ton of GHG abated contribute relatively more to the sustainability of host countries

(*footnote continued*)
RE-CDM projects represent 41% of existing projects in the PCF, 85% in CERUPT and 36% of all projects according to Point Carbon.

[16]The incentive per kWh provided by the sales of CERs (0.3–0.8 €cents/kWh) is relatively low compared to current support levels in MS using feed-in subsidies [16, p. 11].

[17]Even at 100$, renewable generation would only represent 4% of total new generation. At 10$, renewable projects would receive a boost of only 0.1–0.2 cents/kWh, while conventional generation options typically cost 1–3 cents less per kWh and offer less intermittent power. The authors also show that an increase in the CER price leads to a proportionally higher increase in renewable electricity projects.

[18]Dinesh Babu and Michaelowa report percentages between 1% and 5% [8], Painuly and Wohgelmuth estimates are between 0.5% and 3% [20], for Salter between 0.5% and 3.5% [5] and Haites between 1% and 3% [10].

Table 1
Transaction costs of RE-CDM project types

Project types	Typical reduction ($t\ CO_2e$/year)	Transaction costs (€/$t\ CO_2e$)	Size category
Large hydro, geothermal, large CHP and gas power plants, landfill/pipeline methane capture, cement plant efficiency, large-scale afforestation	>200000	0.1	Very large
Wind power, solar thermal, energy efficiency in large industry	20000–200 000	0.3–1	Large
Small hydro, boiler conversion, DSM.	2000–20000	10	Small
Mini hydro, energy efficiency in housing and SMEs	200–2000	100	Mini
Solar PV	<200	1000	Micro

Source: [21].

Table 2
An overview of the factors negatively affecting RE-CDM projects

Long lead times to generate emissions reductions.
Baselines negatively affected by proactive country RETs policies and difficulties in demonstrating additionality.
Greater impact of up-front costs, risk and transaction costs (given small size and other features).
Lack of knowledge and awareness by financial institutions and difficulties in obtaining finance (banks regard RE-CDM projects as risky investments).
Usually small projects and relatively more negatively affected by low CER prices.
Lack of definition of sustainability priorities by host countries.
Low per installation carbon abatement. Relatively higher costs per CER issued (longer pay-back periods).
Incentive to find least cost CERs and existence of lower cost projects.
Low CER prices (5$/t) offered by some international and country funds.[a]

Source: Own elaboration.
[a]According to Salter [5], the influence of both the World Bank's Prototype Carbon Fund and the Dutch CERUPT programme in these early stages of the market has driven the choice to low-cost technologies.

(i.e., RE-CDM projects).[19] There is thus a market failure, since the aforementioned higher contribution to sustainability has no market value (i.e., it is not included neither in the CER price nor in any other currency). This justifies additional support for RE-CDM projects. The following section provides several suggestions in this regard.

4. An analysis of the options to encourage the deployment of RE-CDM projects

The literature on the measures to mitigate the barriers to RE-CDM projects is virtually non-existent. The studies do not normally take into account all the barriers and propose a very limited number of solutions. No paper we know of analyses the implications of different measures.

[19]The rigidity of the CDM cost curve reflects the joint effect of transaction and abatement costs (i.e., the fact that project options higher up the marginal cost curve also carry higher transaction costs) [21].

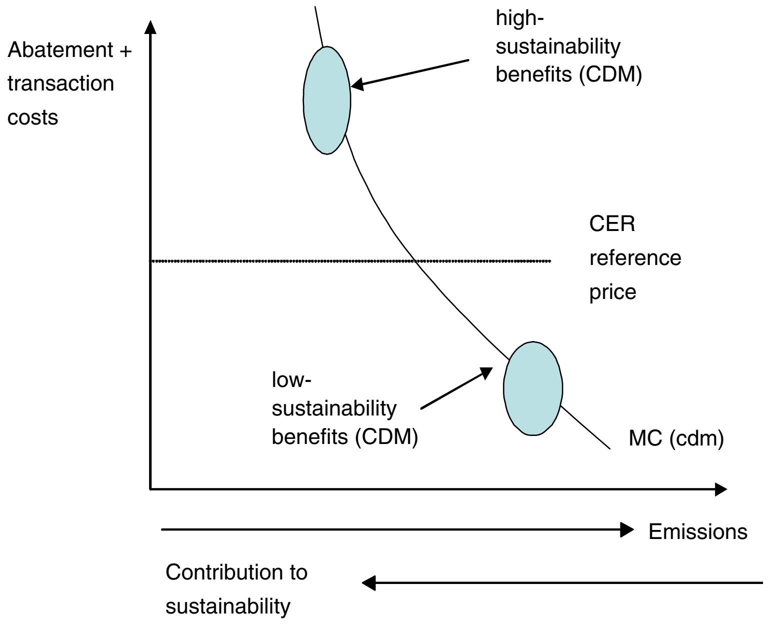

Fig. 2. Illustrating the trade-off between sustainability benefits and GHG mitigation costs in CDM projects. *Source*: Own elaboration.

4.1. Assumptions and justification for additional promotion of RE-CDM projects

This section is based on some major assumptions:

1. RE-CDM projects are more expensive than other alternatives. This assumption is supported by several studies carried out by other authors including institutions involved in market analysis (i.e., Point Carbon).
2. RE-CDM contribute more to the sustainability of the host country than other CDM alternatives.
3. A market failure exists, whereby the higher contribution to host-country sustainability is not internalised in the decisions of private investors (i.e. not included in a currency). Additional support for these projects is then justified to correct this market failure.
4. Long-tem climate protection will require the diffusion of currently expensive RETs. Therefore, supporting RETs now may allow the future reduction of the cost of these technologies, contributing to that goal.

4.2. Measures to encourage the implementation of CDM projects in general

Although the focus of this paper is on RE-CDM projects, we first briefly consider several measures to encourage the implementation of CDM projects in general, on the assumption that what generally affects the CDM also affects RE-CDM more specifically. These barriers and measures are summarised in Table 3.

Table 3
Measures to tackle the barriers to CDM projects

Barrier/Problem	Measures proposed to tackle barriers
Delays	
Delays in approving project methodologies by the Executive Board (EB) due to heavy work load.	• More financial and human resources to the EB, which should have a more professional and permanent nature (dedicated, full-time staff). • EB and Meth Panel open and institutionalise more direct channels of communication with investors and project proponents. • DOEs take a greater share of responsibility for project approval, acting as certifiers.
Practical difficulties in assessing additionality and defining baselines	• Pre-approved methodologies for small-scale projects (additionality for these projects should be assumed). Simplified mechanisms for micro projects (<1 MW). • Detailed, approved guidance for selected CDM project activities. • Top-down baseline methodologies rather than project-by-project approach. • Standardize methodologies for each sector/technology (multiproject baselines). • Allow policy-based and sectoral-based CDM. • More flexibility by the EB in its approach to approvals.
Lack of institutional capacity in host countries leading to lack of definition of sustainability criteria, lack of capacity to identify and assess potential projects and delays in approving projects.	• Host countries prioritise the approval of CDM projects and set up the project approval criteria and processes and required institutions (DNAs). • Capacity building activities build on work already undertaken in developing countries, be a continuous, progressive and interactive process, involve learning by doing and use existing institutions [3]. • International and bilateral cooperation funding devoted for capacity building. • Coordination among donor countries sponsoring capacity building programmes (promote cooperation across government agencies, train and prepare for national DOEs, enable actors to develop CDM projects, develop Project Design Documents (PDDs) domestically for registration, public/private partnerships for data collection and PDD, experience sharing and solve financing issues of CDM).
Difficulties in setting DNAs (constraints in the supply of financial and human resources, difficulties in replicating other countries' DNAs…)	• International resources and capacity building programmes supported by international institutions, bilateral cooperation and Official Development Aid (ODA) funds. • Potential CDM investors and/or investors' funds carry out similar functions to DNAs: provide technical assessment and information of projects, indicate sustainability indicators or outline a list of favoured project types or locations.
Transaction costs	
High transaction costs for projects and parties	• Support for PDDs development (already available from some investor countries). • Pre-approved methodologies for small-scale projects.

Table 3 (*continued*)

Barrier/Problem	Measures proposed to tackle barriers
High project search costs	• Encouraging potential host-country project participants to propose project ideas. • Facilitating initial technical appraisal in the host country.
High project validation and verification costs	• Encouraging the development of validators and Designated Operational Entities (DOEs) in host countries. • A random audit procedure is proposed to avoid verification in all cases.
Risks	
Absence of post-Kyoto targets and post-Kyoto regime.	• Difficult solution. Negotiations currently taking place. • Parties ensure investors the value of their emissions reductions post-Kyoto 2012 through: (i) inclusion of an option for post 2012 CERs in purchase contracts currently being negotiated by governments; (ii) commitments by investor countries to continue domestic emission trading programmes allowing the use of CERs beyond 2012; (iii) international agreement that existing commitments remain in effect until new commitments are negotiated [10].
Uncertainty on the value of CERs	Project developers enter into an Emissions Reduction Purchase Agreement (ERPA) with buyer
Risks and uncertainties associated with generating CERs at the national (investors need to be sure that host country legislation allows transfer of CERs) and the international level (approval by DOE and EB).	• No simple solution.
Loose, vague or too restrictive definitions of sustainability.	• International financial institutions, donor agencies, multilateral institutions and NGOs intensify assistance to host countries to define national sustainability. • Parties explore the elaboration at the international level of criteria guiding national efforts to define sustainability.
Lack of information on the CDM	
Lack of information on the CDM (particularly, on the eligibility criteria and national guidance on designing CDM projects).	• Multilateral and other institutions promote the development of forums for discussion of the CDM, coordinate the dissemination of information on the CDM, encourage initiatives for learning by doing and raise the awareness of decision makers. • Host governments provide information.
Market problems	
Low CER prices	• Ambitious post-Kyoto targets. • Strong mitigation commitments by Annex I countries.
Low share of projects leading to substantial SD benefits	• Tax incentives (by host countries) and premium purchasing and higher demand for high-development projects (by Annex I countries or Carbon Funds). • Green Investment Schemes. • Unilateral CDM.

Table 3 (*continued*)

Barrier/Problem	Measures proposed to tackle barriers
	• Special track for small-scale projects (additionality demonstration). • Include CDM sink projects in agriculture and avoided deforestation.
Access to financing	
Difficulties in accessing financing	• Agreeing on forward ERPAs. • Obtaining up-front finance from potential CER buyers. • Explore the potential offered by ODA. • International financial institutions and governments should increase their support for investment funds. • Use the opportunities offered by the various bilateral cooperation programs to develop projects likely to benefit from the CDM. • Export credit agencies develop innovative risk management products specifically geared for CDM investment. • Governments and multilateral institutions should focus on project financing rather than on purchasing CERs. • Multilateral development banks inject liquidity into developing countries capital markets with the condition that lending be earmarked for climate change issues identified by host-country governments.
Lack of awareness on the CDM and its benefits among potential financiers	• Raise awareness of the CDM to local/national development banks in the developing world.

Source: Own elaboration from [8–10,13,18,22,23].

4.3. Promoting the deployment of RE-CDM projects

4.3.1. Specific measures to be taken by different stakeholders

Since there are several stakeholders involved in the deployment of CDM projects in general and RE-CDM projects in particular, a closer look at specific (realistic) measures that these actors could implement to encourage RE-CDM projects is worth taking.

- **Host countries**: They would benefit by using the CDM to help meet sustainability goals through the deployment of renewable electricity.

1. Streamline procedures. Make certain small RE-CDM projects (i.e., off-grid PV or solar thermal) automatically qualify for sustainability contribution. Facilitate the granting of administrative authorisations to deploy RETs and grid connection.

2. Promote the realisation of unilateral RE-CDM projects and, if possible, provide funds to cover additional costs of RE-CDM projects with respect to low-cost projects (see Section 4.3.2), although this conflicts with the general scarcity of those funds in host countries, however. Promote the bundling of small-scale RE-CDM projects.

3. Elaborate a list of sustainability priorities which can be tackled by RE-CDM projects. Host countries should prioritise CDM projects which are more in line with their national sustainability objectives and should build the necessary infrastructure to do so.

4. Identify potential RE-CDM projects and make this information available to potential investors and project developers (including utilities) in developing countries.[20] A "CDM clearinghouse/support agency" within a public renewable energy or energy agency could be set up, examining potential CDM projects, providing project proponents with match making services with buyers, trying to contact potential CDM investors and informing them on their priorities on possible projects. This unit could also coordinate government cross-departmental thinking and provide adequate information on RETs and CDM to potential investors and other stakeholders in host countries. International funding sources (multilateral and bilateral) could contribute in this regard.

5. Encourage the private sector and foreign investors to finance renewable electricity projects as RE-CDM projects.

6. Awareness and training courses for host-country government departments involved in energy and environmental issues and in CDM approval as part of capacity building.

7. Encourage national financing institutions and banks to provide exclusive funding portfolio for RETs and CDM.

- **Executive Board**

1. *Streamline and simplify administrative procedures for RE-CDM projects*: Some simplifying procedures have already been approved for small-scale projects.[21] De Gouvello and Coto [24] show that these reduce their transaction costs to between 8000$ and 80 000$ (compared to 100 000$ to 1.1M$ for regular CDM projects). However, transaction costs for small projects are reduced per ton of CO_2e to the same order of magnitude as for regular CDM projects [10] but they are still higher for small projects per ton of GHG abated. Although reducing project lead times is not an easy task, additional efforts should be made. The EB could set specific streamlining procedures for approval of RE-CDM projects, specifically adapted to their special features (relatively long lead times, intermittency, difficulties in defining additionality and setting baselines, etc.).

2. *Avoid the justification of additionality and allow more favourable baselines*: See Section 4.3.2.

- **Multilateral financial institutions**

1. *ODA for CDM*: Allow ODA and GEF funds to cover incremental costs of RE-CDM projects with respect to low-cost CDM projects, reducing the costs for the investors. Development aid should flow where it is more effective, i.e., where it provides the greatest

[20] Some governments in developing countries have already identified renewable energy potentials and priority areas for developing CDM projects in the power sector (for example, India).

[21] Small-scale projects benefit from simplified methodologies for monitoring and for determining baseline, simplified PDD, ability to bundle several small projects together at various points in the project cycle, simplified provisions for environmental impact analysis, a shorter review period before registration, an exemption from the adaptation fee (afforestation and reforestation projects), the ability to use the same DOE as validator and certifier and lower registration fees. There are also currently detailed, approved, guidance for selected CDM project activities, including small and larger scale RE-CDM projects (grid and off-grid) [13].

(sustainable) development rewards. Therefore, ODA funds should be allowed to directly support RE-CDM projects and to help build institutional capacity in the host country although these funds should not be used to buy the CERs. ODA funds contributing to the incremental costs of these projects should not be deducted as ODA from the donor country. Within these projects, the cheapest should be supported first, encouraging some cost competition between these projects. Probably, development aid would be more effectively used in this case (compared to conventional development aid flows), mitigating the possible corruption in the management of these funds.

2. *RE-CDM priority*: Prioritise the granting of ODA funds to RE-CDM projects, up to a certain share (or absolute amount) of total funds. This would ensure that some funds are earmarked for these projects but that they do not exhaust the entire ODA budget.

- **Investors**

1. *RE-CDM "label"* (see Section 4.3.2).
2. *Use innovative financing mechanisms* (see Section 4.3.2).
3. *Use the opportunities* offered by several cooperation programs (Canada, France, Germany) to develop projects likely to benefit from the CDM [9].

- **Investor country**

1. *Technical assistance*: Provide special technical assistance in bilateral cooperation programmes for RE-CDM projects.
2. *Transfer relevant knowledge and experience* with RETs deployment and administrative procedures to non-Annex I countries. Training host-country officials in the new technologies could contribute to their increased diffusion in RE-CDM projects by mitigating the "other" barriers to RETs (administrative procedures, grid connection, etc.).
3. *Fiscal incentives*: Provide tax exemptions to Annex I firms investing in RE-CDM projects. At a time of tight public budgets, the incentive for Annex I countries to do this on their own could be small, however (except possibly if some of the CERs accrue to the government). The sustainability benefits would mainly rest in the non-Annex I country, while fiscal incentives would increase the public deficit of the Annex I country. Some countries (Finland) have created carbon funds prioritising the investment in RE-CDM projects.
4. *Tax diffused sectors*: The emissions in the transport and residential sectors are not easy to tackle with emissions trading and are expected to make it difficult for some Annex I countries to comply with their Kyoto Protocol targets. Taxing those sectors and using the funds to encourage the deployment of RE-CDM projects could then lead to a double dividend, at the expense of consumers or taxpayers in Annex I countries.

- **Bilateral cooperation**

Existing and future cooperation agreements between developed and developing countries could provide the additional support (financial, technical and human) necessary for the increased implementation of RE-CDM projects.

- **International negotiations**

Lack of post-Kyoto agreement negatively affects the deployment of RE-CDM projects, given their relatively longer lead times and payback periods and the inherent incentive to engage in projects with shorter lead times (earning as many CERs as possible before 2012). International post-Kyoto agreement would thus help RE-CDM if greater emissions reductions were required compared to 2008–2012, pushing up CER prices.

4.3.2. *Encouraging the deployment of RE-CDM projects: the implications of several theoretical possibilities*

In this section, several theoretical alternatives to promote RE-CDM projects are identified and their implications analysed.

1. *Avoid the justification of additionality and allow more favourable baselines*: Justifying the additionality of certain projects and/or defining appropriate baselines can be particularly difficult (given the many variables at stake in the electricity sector) and prohibitively expensive for RE-CDM projects.[22]

Some conflict between having an integrated, long-run renewable electricity promotion scheme and the incentives for implementation of RE-CDM projects in the host country could exist. If the host governments highly supported renewable energy sources in those countries, then the additionality of RE-CDM projects could be affected and/or baselines would be less favourable for investors (less CERs earned). In principle, this should not prevent host country governments from implementing long-term renewable energy policies. Subsidising RE-CDM projects twice could be justified, given the aforementioned "market failure". The CERs could account for the GHG part while the national promotion scheme could subsidise the "sustainability" part (unattractive for investors). Of course, "over-subsidisation" should also be avoided.

Nevertheless, the additionality problem could be mitigated if, for instance, the additionality requirement for small RE-CDM projects was removed ("automatic additionality"). The advantage in terms of increasing the sustainability potential of host countries would probably outweigh the possible environmental integrity and market risks due to these projects not being additional. Another potential problem is that generous baselines would increase the volume of CERs issued, which would tend to reduce CER prices. However, this price effect would be unlikely with small RE-CDM projects, given that they would represent a small share of the total CERs created.[23]

[22]For example, Kharta et al. [25] show that the baseline study costs for a 100 kW hydro mini-grid can be 543% of CER value and 9% for a 10 MW wind farm (at a CER price of 3$/t$CO_2$). As mentioned by CornerHouse et al. "none of the remaining renewable projects being developed under the Dutch CERUPT program have demonstrated that they "would not have happened otherwise". Indeed, the first CERUPT project to seek approval (the Suzlon wind farm in India) "was withdrawn in May 2004 because it was blatantly non-additional" [26].

[23]For example, Bosi [27] found that the risk to environmental integrity of presumed additionality for small-scale renewable projects may be acceptably small, primarily because the overall power generation share of these projects is very small. Kharta et al. [25, p. 560] argue that, then, more through baseline and additionality methodologies can therefore be reserved for projects presenting greater environmental risk, i.e., larger projects using more conventional technologies. In general, the following factors are key to provide standardised baselines for certain technologies: small amount of emissions credits (i.e., little capacity to absorb baseline transaction costs), potentially large sustainability benefits and low environmental integrity risks.

A multiproject additionality test specifies a quantitative standard (a carbon intensity benchmark or a maximum penetration level of the technology) or a qualitative standard (for instance, experts define a pre-approved set of technologies to automatically qualify as additional) and declares a project to be additional providing it satisfies these standards [17,25]. This may be particularly favourable for RE-CDM projects. Some would argue that this method is arbitrary and non-transparent, while for others standardised baselines provide predictability, transparency and comparability.[24]

On the other hand, different baselines can be used in electricity generation CDM projects. The ''conservative'' approach generally favoured by the Executive Board should be made more flexible, allowing RE-CDM projects to apply more favourable (or simpler) baseline alternatives. For instance, the baselines could be calculated according to a previously set standard value, such as the current electricity generation mix assuming that no RES-E generation in the future (2010) will occur and that all electricity generation will be covered by conventional sources. Again, the disadvantages in terms of environmental integrity would be outweighed by the aforementioned benefits.

2. *Allow sectoral/national CDM*: It is very difficult to elaborate appropriate baselines for RE-CDM in many developing countries, given the lack of accurate data.[25] A good alternative to justifying additionality and defining baselines might be to allow ''sectoral'' or ''national'' CDM, i.e., to allow host countries to receive CERs for the GHG emissions reductions caused by national policies, even if these were not taken for climate policy reasons. National policies aimed at substituting renewable for conventional electricity would then be considered a ''sectoral CDM project'' and be credited with CERs. However, the emissions reductions caused by those policies would still need to be measured, which may be problematic given the aforementioned data problems. The problem of baseline definition would still not be entirely solved, since the BAU emissions should be calculated. In addition, these alternatives could create other problems. For example, if the policy was not restricted to the substitution between conventional and renewable electricity, it would give credits to many BAU activities (such as the substitution of coal-based generation for CCGT plants), substantially increasing the number of CERs in the market, reducing their price and the incentive to implement RE-CDM projects.

3. *Unilateral projects*: After the EB decision in February 2005, unilateral CDM projects are allowed, meaning that host countries themselves may invest in a RE-CDM project and earn the resulting CERs. These countries have an incentive to fund these projects, given their high local sustainability benefits and, particularly, the environmental impact of increasing energy use. Since most host countries do not have the necessary financial resources, the investment in unilateral RE-CDM projects would probably be insignificant.[26]

4. *Host-country bidding*: The host government should investigate which RET alternatives are most viable and encourage funding of RE-CDM projects. For example, it could invite

[24]For example, those authors propose a baseline for renewable options between 0.1 kg C/kWh (which is approximately equal to the carbon intensity of a new CCGT facility and 0.16 kg C/kWh, which is the average carbon intensity for all new generation coming on line up to 2012, according to IEA forecasts.

[25]Including unavailability of data on electricity sector, unreliable emission inventories, projections and GHG accounting systems.

[26]According to Haites [10], however, the projected annual investment requirement for energy projects (made by the IEA) is about 35% higher than the annual FDI. This would confirm that at least some of the capital for energy projects will be raised domestically.

interested native and foreign investors to submit financial and technical proposals to develop wind parks at preselected locations in the most promising sites through a tendering procedure. The government would supply part of the funds necessary for the implementation of RE-CDM projects by successful bidders.

If the additional contribution to sustainability of these small projects was assumed for simplicity to be equal to the project incremental costs (compared to other CDM project types), then support (from the host or investor country or from international institutions) would cover the incremental costs. The competitive disadvantage with respect to other project categories would be removed.

$$\text{Additional contribution to sustainability of RE-CDM projects} \\ = (\mathrm{COST}_{\mathrm{Ren}} - \mathrm{COST}_{\mathrm{low-cost}}),$$

where $\mathrm{COST}_{\mathrm{Ren}}$ is the total costs of the RE-CDM project, $\mathrm{COST}_{\text{low-cost}}$ the total costs of low-cost CDM projects with which the RE-CDM project competes.

Although the justification for the subsidy to RE-CDM projects lies in their sustainability benefits, in reality the subsidy reduces the emissions reduction abatement cost faced by investors.

Not only the amount but also the type of support provided may be relevant. For example, a significant barrier to RETs is their relatively high up-front costs. If up-front investment subsidies or low-interest loans on these investments were provided, this would complement the CDM, which provides funds (from CER revenues) on a more regular basis. Recall that access to funding is a major challenge for renewable electricity projects.

5. *CDM quota*: Low CER prices are a crucial barrier to the deployment of RE-CDM projects. Requiring a CDM minimum share in the total mitigation efforts of Annex I countries would increase CER prices, while simultaneously ensuring the implementation of a number of CDM projects. If this CDM quota was high enough, then the price of CERs would be high enough to benefit RE-CDM projects. This would involve a change of mentality with respect to the CDM. Until now the concern has been to limit the maximum role of the Kyoto Mechanisms in the form of supplementarity (i.e., that Annex I countries carry out actions in their own countries and not abroad, based on "fairness" arguments). However, not having enough RE-CDM projects implemented is also perverse, given their contribution to host country sustainability. Requiring that an ambitious minimum of the commitment be met by CERs from CDM projects would have a positive indirect impact on RE-CDM projects, because the marginal cost of the last projects necessary to reach the CDM quota would be higher than if this quota did not exist, leading to a higher CER price (a RE-CDM project would probably be the marginal provider). The lowest-cost CDM projects would be implemented first but, if this CDM target was ambitious enough, more expensive alternatives would be needed (i.e., RE-CDM projects) to reach the CDM quota. A penalty on those countries failing to surrender the required CERs at the end of the commitment period should be set. This penalty should be related to the market price of CERs. The funds collected from payment of the penalty could be used to support renewable electricity projects in developing countries.

Of course, this proposal also has its drawbacks: it would reduce the cost-effectiveness of GHG mitigation. The extent to which this efficiency loss is (totally or partially) compensated by the "sustainability" benefits for the host country should be estimated as

well as how costs and benefits are shared between different countries and actors. This is difficult to calculate.

6. *RE-CDM quota*: Apart from a CDM quota, a total "RE-CDM quota", as a share of total Annex I countries reduction target could be created at the international level and per country. Similar to the idea of "renewable energy supplementarity", Annex I countries would be required to meet part of their post-Kyoto commitment with CERs from a pre-specified category of RE-CDM projects. Non-Annex I countries would probably agree, since these projects contribute to their sustainability. Setting this quota might also bring some benefits to Annex I countries for two reasons: (a) technology suppliers in these countries could increase RETs exports and access new markets, (b) encouraging the deployment of RE-CDM would be a way to gain the support of non-Annex I countries for the post-Kyoto and long-term mitigation regimes, which is crucial for long-term and global GHG mitigation efforts. This is so because many non-Annex I countries were initially against the CDM, since they believed it was designed to help rich countries buy their way out cheaply. The "sustainability dimension" was then included in the CDM to gain the support of poorer countries, which expected a flow of funds from Annex I countries. However, so far the CDM has not fulfilled the expectations concerning the sustainability contribution because most CERs issued are from CDM projects leading to small host-country benefits.

This quota would also mean that Kyoto targets would necessarily be met at higher costs, however, given that lower cost opportunities would not be totally exploited before higher cost alternatives (RETs) were considered.

In addition, a total RE-CDM quota as well as RE-CDM quotas per Annex I country would have to be set. Establishing the overall quota would be difficult enough, because renewable electricity potentials in most non-Annex I countries have not been calculated. Negotiations to agree on the quota per Annex I country would be even more arduous.

7. *Linking CDM to other instruments*: The CDM could be linked to other energy and environmental policy instruments and goals. For example, a link with renewable electricity policies in general and quotas with tradable green certificates (TGCs) in particular could be made. However, this interaction between instruments has some positive and negative sides, which have already been analysed in depth in other papers (see [28,29]). This linkage might be problematic and would lead to, both, conflicting and synergistic effects, depending on the design of the linkage and the actor and variable considered.

8. *Only one goal for the CDM*: According to article 12 of the Kyoto Protocol, the CDM has two goals: cost-effective GHG mitigation and contribution to sustainable development. The problems encountered in the implementation of RE-CDM projects confirm that both goals can be conflicting to a certain extent. Is it then appropriate to have one instrument to reach two goals? Some would argue that the CDM should only aim at cost-effective emissions reductions and that the sustainability goal should be achieved with other instruments.

However, this suggestion neglects the mutually reinforcing relationship between sustainable development and climate change and the very foundations on which this instrument was built. It implicitly assumes that, when the CDM was approved, both goals were not interrelated. The fact is that less developed countries accepted the CDM because of its sustainability dimension. Sustainable development and climate change are interrelated in complex ways (see [4]). Probably what is needed is more integration and synergy between both goals, not separation.

9. *Recycling revenues from low cost CDM projects*: Another option would be to tax low-cost CDM projects and use the revenues to promote RE-CDM projects, encouraging investors to turn to these projects at the expense of low-cost ones. This would be a wrong proposal, however. Low-cost projects should not be demonised. They serve a crucial goal: cost-effective GHG emissions mitigation and their implementation is also fraught with difficulties. Supporting RE-CDM projects at the expense of other CDM project categories would kill the entire CDM instrument because, in turn, it competes with other options (JI projects, IET and Annex I countries emissions reductions). Taxing low-cost CDM projects would reduce their "cost-effective" attractiveness and put them at a competitive disadvantage versus those alternatives. Any policy aimed at encouraging the implementation of RE-CDM projects should avoid this zero-sum game.

10. *Minimum CER price*: Some host countries are already unhappy with the current low CER market price and have discussed setting a minimum price before approving CER sales [21]. In theory, a higher CER price could favour RE-CDM projects because it would increase their profitability and viability threshold. The problem is that, similarly to number 9, cost-effectiveness would be negatively affected, which would reduce the attractiveness of the CDM versus the other Kyoto Mechanisms with which it competes. Host countries should thus be careful when requiring higher CER prices.

11. *More CERs for RE-CDM projects based on incremental costs*: RE-CDM projects are usually small ones. Therefore, they cannot profit from economies of scale in obtaining CERs and the total amount of CERs issued to these projects is relatively small. Their low profitability could be enhanced by issuing more CERs per unit of GHG emissions abated to these projects. For example, 1.5 CERs would be issued for RE-CDM projects per unit of CO_2e emissions abated, while only 1 CER would be issued for other CDM project categories. While this idea is theoretically robust (for example, it has been used in TGC markets to promote the more expensive RETs) and it would make RE-CDM projects more attractive, it would lead to many practical problems. For example, how many CERs should be granted? If the criteria were that those additional CERs should cover the additional costs of RE-CDM projects, compared to the costs of "average" (or low-cost) CDM projects, then "the average CDM project" should be defined. It would be difficult to objectively find this "yardstick" and that all the involved actors agreed with it. In addition, would it be really possible to measure the additional costs of RE-CDM projects with respect to other projects? Project developers have this information and they would be unlikely to provide it (or to behave in a non-strategic way when providing it). Finally, the same project could have different costs in different locations. Should the incremental costs be calculated on a project-by-project basis (leading to high transaction costs) or should a standard be used (risk of concentration of projects in a few locations)?

12. *More CERs for RE-CDM projects based on incremental sustainability benefits*: More CERs could be issued for RE-CDM projects according to their additional sustainability benefits (compared to lowest-cost project). This would involve valuing those benefits. CERs issued to cover them would provide additional incentives for investors. Again, the practical difficulties in estimating those benefits would make this alternative unfeasible. In this case even more problems would result, given that it is probably harder to estimate (in monetary terms) the sustainability benefits than the incremental costs. Granting of those extra CERs would mean a net increase in global carbon emissions (i.e. credits that are not backed by real reductions) which, however, might be acceptable if the extra emissions in

the near term were compensated in the long term, by inducing greater reductions later [17]. These extra CERs allocated to RE-CDM projects are not problematic as long as their total amount is not large. Otherwise the CER market would be affected and the environmental integrity of the scheme would be compromised. In this context, there is thus a trade-off between encouraging RE-CDM projects and ensuring the environmental integrity of the CDM.

13. *Create "sustainability CERs"*: While the GHG benefits have a monetary value attached (the CER price), the "local" (host country) sustainability benefits do not have a market value. If a monetary value to those benefits was attached by including them in a tradable currency and given to the CDM project investor, then the attractiveness of these projects could be increased. This is a very unrealistic situation, however. First, it is impossible to measure all those local benefits in monetary terms. In addition, some type of "target" should be set (like in the GHG emissions case) in order for that currency to have a trading value.[27] This is simply impossible to do. Third, even if trading of those local benefits was possible, it would not make much sense, since by definition the benefits are "local", which is not the case in GHG trading.

14. *Reputational CER seal*: The issue for investors is how they can recover the higher costs of a RE-CDM project compared to cheaper alternatives. In this context, a distinction should be made between three types of investors: (a) those who are only concerned about their GHG targets and want to receive as much CERs as possible per dollar invested; (b) project investors who are also technology suppliers and gain from exporting the technology in addition to receiving the CERs; (c) "Institutional investors"(like country carbon funds, such as the Finnish one or multilateral carbon funds, like the World Bank's Community Development Carbon Fund) are more likely to value other non-GHG emissions reductions benefits of RE-CDM projects.

"a" Investors would not likely pay the incremental cost of a RE-CDM project and, thus, would not invest in these projects, while the other investors would have some incentive to do so. Therefore, the issue is how to encourage "a" investors to engage in RE-CDM projects. They will only do so if they see an "added" benefit compared to investing in other project types. While currently this added benefit does not exist, it could be created.

On the one hand, NGOs in Annex I countries could help by regularly elaborating and publishing a short of "good reputation list" of investors in RE-CDM projects. On the other hand, a "seal", granted by an NGO may differentiate between CERs coming from CDM projects with substantial sustainability benefits and other CERs. This is the case of the WWF's Gold Standard "seal of quality", which is intended to generate reputational and carbon price benefits to those firms using it [5]. Some consumers may be willing to pay for the products of firms with such seal.

The effectiveness of this label in encouraging RE-CDM projects is doubtful, however. First, it assumes that consumers would be informed about what a CDM project is and about the problems faced by RE-CDM projects, so that they would be willing to support the cause. This is unrealistic. Second, it assumes that, even if they had all this information, they would be willing to pay a premium for products carrying this label. This may also be unrealistic.

[27] Otherwise, there would not be an incentive to demand those sustainability CERs and, thus, no CER price would result.

14. *Investors' premium for CERs*: In addition, a premium could be directly paid to investors in these projects, funded by Carbon Funds or by governments. According to Ellis et al. [13, p. 6], some institutional CER buyers are already prepared to pay a premium for development-friendly projects (The Finnish CDM/JI programme, the World Bank's Community Development Carbon Fund (CDCF), the Dutch CERUPT programme). As long as public funding is the dominant source of funding, these premiums may be feasible. It is very difficult to predict, however, what its impact would be on the deployment of RE-CDM projects and whether many governments would have an incentive to pay this premium in the first place. All in all, this premium is unlikely to represent a significant fraction of overall investment and credit volumes [19].

15. *Create "positive" and "negative" project lists*: Annex I countries may give an indirect push to the implementation of RE-CDM projects by disallowing the acceptance of CERs from certain project types to comply with domestic targets. For example by banning or restricting the use of CERs from certain project categories (nuclear, sinks and large hydro), the EU Linking Directive has indirectly prioritised the rest of project types, not to promote certain project types, but to ensure the environmental integrity of the CDM. This environmental integrity argument (i.e., whether specific types of projects constitute real emission reductions, rather than temporary storage) could be a salvation table for RE-CDM projects.

Nevertheless, a "positive list" requiring the use of CERs from certain project categories would be more effective to encourage the realisation of RE-CDM projects.[28] This would create a RE-CDM market within the overall CDM market, directly increasing the price of CERs from RE-CDM projects.

This possibility exists in the EU ETS. The linking Directive allows MS to decide whether to allow CERs to be converted into EU allowances and even the characteristics of such conversion. This opens the door for MS to introduce further restrictions on the types of CDM projects whose CERs are accepted by the MS. MS could thus specify a "CDM-type supplementarity rule", i.e., that a certain share of the CERs converted to EU allowances be from RE-CDM projects.

However, creating such a positive list in the EU may be difficult to enforce since, as noted by Lefevere [30, p. 301], restrictions would need to be harmonised at an EU level to avoid their circumvention by benefiting from the different domestic linking arrangements of another MS.

16. *Innovative financing schemes*: Salter [5] argues that the effectiveness of the CDM will also depend to a large extent upon the ability of the renewable energy developers and financiers to find innovative ways of using CER finance beyond pure revenue enhancement.[29] For example, in unilateral CDM projects, the CERs created could subsidise the interest rate of the investment loans and compensate for the exchange rate

[28] This "positive list" is similar to the idea of RE-CDM quota.

[29] Salter [5] proposes to link CER cash flows to servicing debt obligations instead of pure revenue enhancement. More specifically, his suggestions are: to use carbon cash flow to improve the debt service coverage ratio and allow increased debt finance and improved debt to equity ratios in project finance, to establish a cash reserve account to be applied to debt service in the event of liquidity problems, to fund a cash reserve account that can be hedge against variability of revenues streams, to prepare debt based on forward ERPAs deposit carbon cash flow directly with banks for credit against debt services, thereby lowering liability on electricity cash flow, to use ERPAs and/or forward carbon sales as collateral for loans and to denominate carbon transactions in hard currency.

risk [31]. This would give security to banks investing in the project and, thus, reduce their risk, increase the profitability (reducing the capital costs) and the attractiveness of the project.

5. Concluding remarks and future research

RE-CDM projects are obviously not a panacea that will solve the climate change problem or the development problem. They will probably only make a residual, although still relevant contribution to both. They provide significant sustainability benefits to the host country, while also reducing GHG emissions and contributing to a more sustainable energy system in poorer countries. However, these positive (sustainability) externalities are not valued in the market place, providing the major justification for further support to these projects and creating a "protected niche" for them. This paper has identified and analysed several support measures, taking into account the different barriers to the implementation of these projects.

The major conclusions are:

1. The CDM is likely to generate a very limited push to the deployment of RETs.
2. The trade-off between cost-effective GHG mitigation and sustainability benefits are a major issue in the deployment of RE-CDM projects.
3. Additional support for these projects can be easily justified.
4. Several alternatives specifically supporting these projects can and should be considered. However, while these policy measures are more or less robust in theoretical terms, they usually lack practical realism. Different stakeholders with different interests should be engaged in most of those solutions. This is difficult to achieve.

Given that our analysis is based on the assumption that RE-CDM projects contribute to sustainability to a greater extent than other CDM project types and that those projects are more expensive, these assumptions should be analysed in further, more empirical, type of research. Future research should also try to analyse, with the help of formal modelling techniques, the implications of the different policy options considered in this paper.

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